REPORT

ON THE

Agricultural Station, Orai, Jalaun,

OF THE

UNITED PROVINCES OF AGRA AND OUDH.

FOR THE YEAR ENDING JUNE 30th, 1909.

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From

W. H. MORELAND, Esq., C.I.E., I.C.S.,
Director of Land Records and Agriculture,
United Provinces,

To

The CHIEF SECRETARY to GOVERNMENT,
United Provinces.

Dated Cawnpore, the 23rd of August 1909.

Sir

I have the honour to submit the report on the Orai Agricultural Station for the year 1908-9. The report has been drawn up by Mr. B. C. Burt, Deputy Director of Agriculture, Central Circle.

I have the honour to be,
Sir,
Your most obedient servant,
W. H. MORELAND,
Director.

ERRATA *for the Report on the Orai Agricultural Station for the year ending 30th June* 1909.

In page 1, lines 5 and 6, under '(2) Situation, area and soils', *for* 88·6 acres *read* 86·86 and *for* 13·91 acres *read* 13·41 respectively.

In page 17, January, First half Maximum Mean Temperature at the Orai Agricultural Station, Under shade, *for* 95·3 *read* 75·3.

Report on the Agricultural Station, Orai, Jalaun, for the year ending June 30th, 1909.

CHAPTER I.

(1) PRINCIPAL OBJECTS OF THE STATION.

In general to study the suitability of different crops and varieties of crops to the typical soils of Bundelkhand and the Jalaun district in particular.

To increase the diversity of cropping in Bundelkhand by the trial and subsequent demonstration of additional crops.

Trials in the transference of juar, bajra, wheat, gram and other seeds from other parts of the province in case of importation being necessary after a year of scarcity :—

Wheat.—The testing of the suitability to the Jalaun district of wheats bred at Cawnpore and elsewhere.

Juars.—The testing of the various Bundelkhand juars for their suitability for seed distribution.

Cotton.—The testing of different varieties, and the comparison of different methods of cultivation for suitability to Bundelkhand soils.

Ground-nuts.—Comparison of different varieties for suitability to the district, and the provision of suitable seed.

Cultivation.—Comparison of various methods with indigenous methods, with the object of improving the general standard of cultivation in Bundelkhand.

Utilisation of Waste Land.—The trial of plants likely to be of use as famine fodders or of industrial value on *rakar* soil.

Kans.—Experimental trials of different suggested methods of eradication.

MISCELLANEOUS—*Trial of Implements.*

In addition to the experimental work, the farm forms an important local centre for the supply of seed and implements, and for district work.

(2) SITUATION, AREA AND SOILS.

The Experimental Station is situated about one mile from the Orai Railway Station, on the Great Indian Peninsula Railway, and about an equal distance from the Orai Collectorate.

The land has been acquired by Government and the necessary buildings have been erected by the department. The whole area in possession is 88·6 acres, out of which 13·91 acres have been utilized for building purposes, &c. A distributary of the Betwa Canal supplies water to all parts, but the supply of water is at present too limited and irregular to permit of regular irrigation, two, or at most three waterings during the rabi season being the extent of the supply.

This defect is partly due to the position of the farm at the tail of the distributary, but will be largely remedied, it is hoped, by the completion of additional reservoirs at the head of the canal.

The site for experimental work was chosen as being easily approached by rail, near a railway station, and comprising blocks of land fairly representing the four principal soils of Bundelkhand, at the same time separated by no great distance from each other and the office buildings.

The four principal soils of Bundelkhand are *mar*, *kabar*, *parwa* and *rakar*.

Mar block lies to the south-east, about a mile from the buildings in the village of Kuinyan.

Mar.—Is a strong black calcareous loam specially noted for its large deep cracks in the hot weather, its power of absorbing water during the rains and friability when being worked. Lumps of *mar* fracture with a distinct grain, showing small granules of lime and readily breaking down with time and light showers of rain. This soil is chiefly devoted to wheat or wheat and gram. By custom it is never generally manured and requires no irrigation in ordinary years.

Kabar block lies a few furlongs to the north-east of buildings in the village of Ikhlaspur.

Kabar.—Is a dark (usually) clay soil, lighter in colour than, and inferior in quality to, the best *mar*, and generally contains small black pillets which consist apparently chiefly of iron with smaller quantities of silica, manganese oxide, magnesia and lime. It may also contain small nodules of lime. Sticky and cohesive when wet, on drying it hardens and ploughs up with difficulty in large lumps which give a smooth fracture and do not readily break down.

It differs somewhat in colour and clayeyness in different localities and sometimes receives such prefixes as *Loha-kabar*, *Hara-kabar*, &c., in consequence. At the experimental station it is contiguous to *mar* and shades off gradually from this soil. It is devoted chiefly to wheat and gram, mixed, in the rabi, and juar, cotton, &c., according to season in the kharif.

Parwa block lies to the east of the building, about two miles off in the village of Minora Kalpi.

Pandua or Parwa.—Compared with *kabar* it is a light loam. It varies somewhat in colour and quantity with its position, manuring and with different districts and may be *khaki*, brown, whitish or even have a reddish tinge. Easy to work and responding readily to water and manuring, it will grow most crops with these facilities. Without irrigation the principal rabi crop is gram and barley mixed. By custom it is, in villages, reserved for kharif, especially where irrigation is not available.

Rakar block lies a few furlongs to the north-west of the buildings and is also in the village of Ikhlaspur.

Rakar (Stony).—No doubt so called in consequence of the presence of *kankar* nodules. It is found on slopes and along ravines and represents a degraded soil, the result of denudation by running water and the deposit elsewhere of its best material. It varies somewhat with the kind of soil from which it is derived and the amount of erosion to which it has been subjected. Thus we have *mota-rakar* and *patla-rakar*, terms sometimes used loosely, sometimes represented by other names in different places, but which define clearly enough differences in quality that undoubtedly exist. It grows poor crops of juar and bajra in the kharif or gram and the poorer pulses in the rabi.

The following shows the complete analyses, carried out by Dr. Leather, Imperial Agricultural Chemist, of *mar*, *parwa*, *kabar* and *rakar* soils :—

Constituents.	*Mar.*		*Parwa.*		*Kabar.*		*Rakar.*	
	Surface soil 6″.	Sub-soil 6′.	Surface soil 6′.	Sub-soil 6″.	Surface soil 6″.	Sub-soil 6″.	Surface soil 6″.	Sub-soil 6″.
Insoluble silicates and sand ...	74·74	73·96	86·38	84·28	75·93	75·49	76·91	71·35
Ferric oxide	5·59	5·78	3·26	4·25	5·55	5·79	4·74	5·60
Alumina	9·23	8·57	5·42	5·54	9·45	9·68	7·43	8·33
Lime	2·38	2·49	·69	·75	1·78	1·42	2·96	4·84
Magnesia	1·40	2·05	·71	·66	1·27	·96	1·26	1·41
Potash	·81	·74	·52	·45	·86	·90	·65	·74
Soda	·55	·15	·22	·68	·23	·04	·16	·35
Phosphoric acid	·30	·08	·03	·02	·07	·07	·10	·10
Sulphuric acid	·007	·008	·007	·007	·02	·02	·02	·03
Carbonic* acid	·09	·35	·09	·02	·28	·22	·56	1·07
Organic matter and combined water	4·90	5·82	2·67	3·34	4·56	5·41	5·21	6·08
Total ...	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Total nitrogen per cent. ...	·04	·04	·04	·03	·039	·031	·036	·028
Available phosphoric acid per cent.	·010	·008	·014	·007	·0068	·0042	·0042	·0004
Available potash per cent. ...	·015	·016	·011	·008	·031	·009	·015	·020
*Equivalent to calcium carbonate per cent.	...	...	...	...	·63	·49	1·27	2·45

The following shows the mechanical analyses of *mar* and *parwa* soils and sub-soils :—

Diameter.		*Mar.*		*Parwa.*	
		Surface soil.	Sub-soil.	Surface soil.	Sub-soil.
Sand ...	>·25 M. M ...	1·85	2·0	·3	·7
	·25—·032 „ ...	31·90	28·45	46·30	43·9
	·032—·016 „ ...	35·1	35·7	30·05	30·8
	·016—·008 „ ...	7·1	9·75	6·40	7·25
	·008—·004 „ ...	7·6	8·4	5·75	6·0
	·004—·002 „ ...	11·0	11·1	8·00	7·9
Clay ...	<·002 „ ...	1·35	1·05	·85	·85

* These soils contain comparatively very little fine material.

The following shows the mechanical analyses of the *kabar* and *rakar* soils and sub-soils :—

Diameter (millimeter).		Kabar.		Rakar.	
		Surface soil 6".	Sub-soil 6".	Surface soil 6".	Sub-soil 6".
Sand ...	>·16 M. M. ...	3·07	4·04	6·19	6·20
	·032— ·16 „ ...	33·95	34·79	37·89	30·81
	·016— ·032 „ ...	33·03	31·65	31·75	32·12
	·008— ·016 „ ...	9·70	9·54	7·85	9 80
	·004— ·008 „ ...	6·90	6·78	5·54	7·54
	·002— ·004 „ ...	4·51	5·01	4·11	5·32
Clay ...	<·002 „ ...	·68	·66	·55	·48

Relation of these soils to Moisture.—During the year under report, soil borings and moisture determinations have been made at various depths, with the object of gaining some information as to the hygroscopic condition of these soils.

The experiments were carried on in conjunction with the Imperial Agricultural Chemist, forming an extension of his general research on the movements of water in the soil. The full discussion of the results obtained will appear elsewhere, but the appended tables and conclusions appear to be of some local importance.

Originally a series of small plots, 10 feet square, were layed out in each soil, two being sown with gram, two with wheat and four being left fallow for comparison. *

Owing to lack of moisture in the first six inches, wheat failed to germinate on all four soils. The gram plots germinated somewhat irregularly.

Previous cultivation.—The land selected lay outside the experimental blocks proper, and had lain fallow during the previous year. It was cultivated by the local method entirely, i.e., with the *bakhar*.

Borings and moisture determinations were made on *mar* and *parwa* in October (at sowing), January and March at harvest.

Rain (·38") fell during the first fortnight in January, the January borings being taken about a week later.

On *kabar* and *rakar*, borings were taken in October and January only.

Reference to the appended tables brings out several interesting points :—

(1) In the October borings there is a marked difference between the water content of the first and second six inches, thus :—

	Mar.	Kabar.	Parwa.	Rakar.
	Per cent.	Per cent.	Per cent.	Per cent.
0"—6"	11·81	5·91	4·89	7·55
6"—12"	16·98	11·03	12·82	12·70

The actual differences in the field were even more striking, the first three or four inches being practically air-dry.

The fact, that under these conditions gram germinated fairly well while wheat failed absolutely, is of some little interest.

(2) The amount of water, held by these soils at various depths, seems to vary almost inversely (for the same soil) with the amount of *kankar*. Wherever the *kankar* increases, there is a relative diminution in the amount of water found. The *kankar* was directly determined by mechanical analysis.

It was not compact *kankar* as found in the "doab," but consisted of nodules of various sizes—consisting chiefly of carbonate of lime.

(3) Of the four soils, *mar* retains the most moisture down to 6 feet, *parwa* and *kabar* differ very slightly, and *rakar* contains appreciably less—although containing less *kankar* than any. How far this is due to the varying proportion of *kankar* and how far to other physical character, it is not at present possible to say, but the January and March borings preserve the same order, although unfortunately *kankar* determinations were not made for these. The marked difference in the case of *rakar* is probably due largely to its position on a distinct slope. *Rakar* is a general name for any denuded soil and does not represent any distinct variety.

*Local wheat, germinating power of which had been previously tested, was employed.

Mar and *kabar* shade imperceptibly into each other but there are marked differences between the typical soils.

The *parwa* of the Orai farm, contiguous as it is to a considerable area of *mar*, is probably not typical *parwa*. It differs considerably, at any rate, from the *parwa* of the larger recognised *parwa* tracts.

January borings were taken in the growing crop and also in the adjacent fallow plot at a distance of 3 feet from the border.

Harvest borings were taken immediately after cutting the crop :—

(*a*) Immediately under a plant.
(*b*) Between the rows.
(*c*) In fallow land.

Borings (*a*) and (*b*) were made, as near as possible, 3 feet from each other and 3 feet from the January boring ; (*c*) was made 3 feet from the January fallow boring and 3 feet from the margin of the cropped plot in the direction of (*a*) and (*b*).

From a consideration of the figures obtained, we may draw the following tentative conclusions :—

Parwa.—(1) The amount of water in the fallow soil is practically the same at the January and harvest borings as at the October borings.

(2) The growing crop has caused a marked reduction in the water content down to 3 feet 6 inches (the limit of the March boring) and probably (January boring only) down to 5 feet.

(3) The chief reduction in soil moisture by the growing crop took place between October and January, the first half of the growing period.

(4) The differences in water content between the borings under the plant and between the rows are irregular and the total difference insignificant.

Mar. (1) The January fallow borings show, on an average, about 1 per cent. more water than do the October borings ; 0·38″ of rain fell early in January, and assuming that this were all absorbed (it fell in light showers), this would represent an addition of ·4 per cent. on 5 feet of soil.

In any case the difference is of the same order as the experimental error due to local variation, the October and January borings being some 10 feet apart.

Between January and March there is a marked difference in the water content of the fallow plot. The differences, although not large, are regular, and in this respect the indications on *mar* and *parwa* differ.

(2) The growing crop caused a marked decrease in water content down to 5 feet, the limit of the borings.

(3) As in *parwa*, the reduction is most marked for the period October to January.

(4) There is no marked difference between the water content found by borings under the plant and between the rows.

(5) These borings clearly show that below the first six inches *mar* soil retains considerable quantities of water throughout the rabi season. This agrees with practical experience that, given sufficient moisture in the surface soil for germination, *mar* soil is capable of maintaining a crop througout its growing period—a point of considerable importance, both as regards the irrigation of *mar* and as regards its cultivation.

Kabar and Rakar.—Borings were only taken in October and January.

The January fallow boring on *rakar* shows appreciably more water than the October boring down to 3 feet.

The figures obtained, as far as they go, support the conclusion, drawn for *parwa*, that the growing crop reduces the moisture content of the soil down to 3 feet and possibly lower.

It should be borne in mind, in considering these figures, that in black soils much bigger local variations are probable than on the more uniform soils of the doab. Cracks and holes of considerable depth are common, especially on *mar* and *kabar*, and it is easily conceivable that these are not all apparent on the surface.

If possible this investigation will be continued during the coming year. Bundelkhand soils are undoubtedly peculiar in their behaviour and local methods of cultivation fail to secure satisfactory results when there is any abnormality in the

rainfall. Much of the land of this section of the province is, by its position, incapable of irrigation. Hence any information, on the relations of these soils to moisture which might indicate possible improvements in cultivation, is of the utmost importance.

TABLE I.

Showing the percentages of water and kankar in the four soils. Borings taken in October, 1908.

(a) Parwa.

Depth.	% H_2O.	lbs. H_2O per c. ft.	% Kankar.	% CO_2 in soil.
0″—6″	4·89	2·63	...	...
6″—1′	12·82	9·74	...	·08
1′—1′ 6″	16·82	14·44	1·0	...
1′ 6″—2′	17·48	15·27	1·8	...
2′—2′ 6″	17·68	16·95	2·2	...
2′ 6″—3′	16·97	16·70	2·8	·10
3′—3′ 6″	17·15	17·35	2·0	...
3′ 6″—4′	18·85	18·99	...	...
4′—4′ 6″	20·85	21·21	2·8	...
4′ 6″—5′	16·71	16·95	18·8	...
5′—5′ 6″	15·80	15·07	19·2	...
5′ 6″—6′	16·36	16·93	17·2	...
6′—6′ 6″	14·65	14·81	29·9	...
6′ 6″—7′	17·05	17·33	13·3	...

(b) Mar.

Depth.	% H_2O.	lbs. H_2O per c. ft.	% Kankar.	% CO_2 in soils.
0″—6″	11·81	8·25	7·1	...
6″—1′	16·98	15·33	8·0	2·95
1′—1′ 6″	17·97	17·37	6·8	...
1′ 6″—2′	18·39	17·15	7·7	...
2′—2′ 6″	18·95	18·36	5·5	...
2′ 6″—3′	19·66	19·80	4·7	2·39
3′—3′ 6″	18·32	18·00	5·0	...
3′ 6″—4′	20·69	20·70	5·4	...
4′—4′ 6″	20·87	20·02	5·5	...
4′ 6″—5′	20·76	20·02	5·5	2·08
5′—5′ 6″	20·42	21·37	6·8	...
5′ 6″—6′	19·86	20·87	6·4	...
6′—6′ 6″	18·84	20·46	8·8	...
6′ 6″—7′	16·49	17·90	5·0	...

(c) Kabar.

Depth.	% H_2O.	lbs. H_2O per c. ft.	% Kankar.	% CO_2 in soil.
0″—6″	5·91	4·54	8·1	...
6″—1′	14·18	11·03	8·0	2·37
1′—1′ 6″	14·69	12·85	8·9	...
1′ 6″—2′	17·37	16·91	7·6	...
2′—2′ 6″	19·47	18·79	5·2	...
2′ 6″—3′	18·32	19·11	6·0	2·66
3′—3′ 6″	17·59	18·68	5·2	...
3′ 6″—3′ 10½″	15·60	20·98	3·8	...
3′ 10½″—4′ 3½″	12·37	14·33	6·6	...
4′ 3½″—4′ 8½″	11·33	11·03	8·0	...
4′ 8½″—5′	...	...	11·7	...
5′—5′ 2½″	10·24	14·59	8·3	...
5′ 2½″—5′ 6¼″	10·31	13·38	19·2	...
5′ 6¼″—5′ 10″	10·07	13·38	17·8	...

(d) Rakar.

Depth.	% H_2O.	1 lb. H_2O per c. ft.	% Kankar.	% CO_2 in soil.
0″—6½″	7·55	5·50	4·1	...
6½″—1′½″	12·70	11·01	4.1	1·37
1′½″—1′6½″	13·69	13·01	4·3	...
1′6½″—2′	16.36	16·02	6·1	...
2′—2′ 6″	19·08	18·34	4·8	...
2′ 6″—3′	19·08	20·26	4·3	1·43
3′—3′ 5″	16·51	20·48	3·3	...
3′ 5″—3′8½″	13·67	19·70	3·5	...
3′ 8½″—4′ 1″	12·88	15·62	2·6	...
4′ 1″—4′ 5½″	12·86	16·65	4·9	...
4′ 5½″—4′7″	11·68	14·06	2·2	...

TABLE II (*a*).

Showing the percentage of water found in parwa soil, cropped and uncropped, at various depths, during the Rabi season, 1908-09.

Depth.	October (Sowing time.)	January.		March (harvest).		
					Gram plot.	
	Fallow.	Fallow.	Gram plot.	Fallow.	Under plant.	Between rows.
0″—6″	4·9	6·6	4·7	3·4	3·6	3·5
6″—1′	12·8	14·1	11·3	11·7	9·5	6·5
1′—1′ 6″	16·8	17.4	12·3	16·1	10·9	13·1
1′ 6″—2′	17·5	17·9	15·5	17·3	14·0	13·3
2′—2′ 6″	17.7	18·5	14·2	17·5	13·4	13·5
2′ 6″—3′	17·0	18·1	14·5	18·1	13·7(c)	13·3
3′—3′ 6″	17.2	18·6	15·3	18·35(b)	13·4(d)	13·1(d)
3′ 6″—4′	18·9	17·8	17·3	...	...	...
4′—4′ 6″	20·9	16·6	14·7	...	...	...
4′ 6″—5′	16·7	15·2	13·2	...	...	...
5′—5′ 6″	15·8	13·6(a)	16·1	...	...	...
5′ 6″—6′	16·4	...	...	...	...	...

Reference.
(*a*) 4′ 11″—5′ 2″ 15.0%
5′ 2″—5′ 4″ 12.3%
(*b*) 3″—3′3″ 18.5%
3′ 3″—3′ 5½″ 18·2%
(*c*) 2′ 6″—2′ 10″ 13.8%
2′ 10″—3′ 1″ 13.3%
(*d*) To 3′ 2″ only.

TABLE II (*b*).

Percentage of water found in Mar Soil, cropped and uncropped at various depths.

Depth.	October. Sowing time.	January.		March (harvest).		
					Gram plot.	
	Fallow.	Fallow.	Gram plot.	Fallow.	Under plant.	Between rows.
0″—6″	11·81	11·8	9·9	8·1	8·5	7·3
6″—1′	16·98	17·4	10·5	15·8	12·6	12·5
1′—1′6″	17·97	19·6	13·4	15·6	13·1	12·9
1′6″—2′	18·39	20·5	14·6	17·9	13·2	12·5
2′—2′6″	18·95	20·3	14·7	18·5	13·1	14·3
2′6″—3′	19·66	21·8	15·2	18·4	13·1	15·0
3′—3′6″	18·32	21·3	15·4	18·6	13·8	15·0
3′6″—4′	20·69	19·2	14·7	18·9	13·7	14·7
4′—4′6″	20·87	22·1	17·4	19·3	14·4	15·2
4′6″—5′	20·76	21·0(*a*)	17·8(*c*)	19·9	14·3	15·3
5′—5′6″	20·42	21·1(*b*)	19·3(*d*)	...	14·4	15·3
5′6″—6′	19·86	...	...	...	14·2	14·9
6′—6′6″	18·84	...	...	...	15·1	15·5
6′6″—7′	16·49	...	...	...	14·3	14·3
7′—7′6″	...	...	...	...	14·6	14·4
7′6″—8′	...	...	...	...	14·4	14·4

References—
(*a*) Mean of 4′5″ to 4′9″ 21·2 per cent.
4′9″ „ 5′½″ 20·8 „
(*b*) 5′¼″ „ 5′3½ only.
(*c*) to 4′10″ only.
(*d*) 4′10″ to 5′2″ 20·0 } Mean 19·3.
5′2″ „ 5′5″ 18·6 }

TABLE II *(c)*.

Percentage of water found in Kabar and Rakar soils, cropped and uncropped, at various depths.

Rakar.				*Kabar.*			
Depth.	October. (Sowing time.)	January.		October.	January.		Depth.
	Fallow.	Fallow.	Gram plot.	Fallow.	Fallow.	Gram plot.	
0″—6″	5·9	11·4	8·2	6·6	8·6	7·4	0″—6″
6″—1′	14·2	13·3	10·7	12·7	16·1	11·5	6″—1′
1′—1′6″	14·7	14·9	14·2	13·7	18·1	12·4	1′—1′3″
1′6″—2′	17·4	17·5	13·5	...	18·8	13·5	1′3″—1′6″
2′—2′6″	19·5	18·6	14·6	16·4	...	...	1′6″—1′9″
2′6″—3′	18·3	18·3	14·7	...	19·9	14·2	1′9″—2′
3′—3′6″	17·6	17·4(*a*)	18·5(*a*)	19·1	..	...	2′—2′3″
3′6″—3′9″	15·6	14·5	19·0	...	19·7	14·7	2′3″—2′6″
3′9′—4″	12·4	16·2	17·6	19·1	...	...	2′6″—2′9″
4′—4′3″	...	8·1	...	...	19·0	16·5	2′9″—3′
4′3″—4′6″	11·3	...	...	16·5	16·6	16·1	3′—3′3″
	...	...	...	...	15·3	...	3′3″—3′6″

(*a*) To 3′5″ only.

Exact 6″ borings were not possible. Results expressed to the nearest 3″.

CHAPTER II.

TRIAL OF DIFFERENT VARIETIES OF CROPS.

Cotton.—The comparison of Bani and Jalaun *kapas* was continued. The Bani crop was an entire failure owing to excessive rain in August. The outturns of Jalaun *kapas* were almost nominal.

Table showing outturns of Jalaun kapas and Bani duplicated on four parwa plots in 1907—1909.

Variety.	Outturn in lbs. per acre (kapas.)			Remarks.
	1907.	1908.	1909.	
Bani ...	97	90	Failed	Bani has always been late, and in the first two years suffered badly from insect attacks.
Jalaun ...	291	207	56	
Bani ...	71	115	Failed	
Jalaun kapas ...	262	169	69	

Trial of Gwalior cotton on Rakar.

Variety.	Outturn in lbs. per acre. (kapas).	Remarks.
Gwalior cotton ...	153	
Jalaun cotton ...	122	
Gwalior cotton ...	298	
Jalaun cotton ...	195	

Owing to the continuous rain in August, cotton on *rakar* did better than usual compared to similar crops on *parwa*.

The Gwalior variety grew well and shows a distinct advantage over the local variety.

The trial is being continued.

Ground-nuts.—Five varieties were again tried on unmanured plots on *parwa.*

Variety.	Outturn in lbs. per acre.			Remarks.
	1907.	1908.	1909.	
Madrasi ...	881	95	55	
Spanish pea-nut ...	1,107	685	381	
Virginia ...	1,586	590	740	
Japanese, small ...	725	230	278	
Pondichery ...	1,332	570	381	

The Virginian variety has done consistently best during the three years, and this variety is being sown during the coming year on a larger scale on manured land, both for outturn and for seed supply.

The Madrasi and "Small Japanese" varieties have been discontinued as unsuitable.

Other imported varieties that have done well under similar conditions in other parts of India, are being tried this year in comparison with the three remaining varieties mentioned above.

The low outturns this year are due to the early cessation of rain in September and the absence of canal irrigation in October. Consequently, although the plants flowered freely, a large number of the shoots were unable to enter the ground and form fruit.

The experience of various zamindars and cultivators, both in Jalaun and in adjoining districts, has shown that this crop is well adopted to *parwa* soil, especially where sufficient irrigation facilities exist to give the crop one irrigation, if necessary, at the time of flowering.

There is a steadily increasing demand for seed.

Juar.—Of the Bundelkhand juars mentioned in the 1906 and 1907 reports, twenty-seven varieties were sown on small plots for further study and to obtain sufficient seed for future testing.

The undermentioned varieties were apparently true to type.

Group A.	Group B.	Group C. (a)
A1 ...	B1 Unknown ...	(1)
Andhri	B2 Ghush ...	C1 Ankhmundi ...
		C1a Dudhnagar ...
		C2 Bansmati ...
		C3 Dol ..
		C4 Makka ...
		C5 Gogla ...
		C7 Charka ...
		C10 Wazir ...
		C11 Charka No. 1 ...
		C15 Khowa ...
		C16 Bansmatia ...
		C26 Gudlari ...
		(2)
		C27 Sufed Eksara ...
		(3)
		C31 Mandaraji. ...
		C35 Karwi. ...
		C39 Ghasua. ...
		C46 Baidra. ...

The more promising of these juars are being sown during the coming year on one-tenth acre plots for comparison of outturn and further study, whilst the different types occurring in those which did not prove true to type, are being sown on a small scale with the object of isolating pure types if possible.

Comparison of Andhri and Lal Dohra.

These two varieties were sown on duplicate plots on all four soils for outturn, the results being given in the following table :—

Variety.	Outturn in lbs. per acre.				Remarks.
	Mar.	Kabar.	Parwa.	Rakar.	
Andhri ...	170	500	960	750	On *mar* and *kabar* the crop was slightly injured by water-logging.
Lal Dohra ...	260	595	740	460	
Andhri ...	470	930	1,140	830	
Lal Dohra ...	290	820	873	830	

Of the two, Andhri gave consistently the better yield. It is also considered by cultivators to yield the better grain of the two and came true to type. Lal dohra split up into single and double grained types, both types in some cases appearing on the same head.

An attempt is being made during the coming year to determine if this character is constant and to isolate the two types.

Comparison of Cawnpore and Local juars when sown as a mixed crop with arhar.

Variety.	Outturn in lbs. per acre.	Remarks.
	Juar.	
Local juar and arhar ...	930	
Cawnpore juar and arhar ...	595	
Local juar and arhar ...	940	
Cawnpore juar and arhar ..	755	

The local juar (probably identical with C27) proved the better of the two.

Wheat.—The following varieties were sown on duplicate plots of one-tenth acre for outturn and comparison.

Most of them are Australian varieties obtained from the late Mr. Farrer.

Australian.	*Indian.*
Etawah A.	Kathia (local).
Fife's Indian.	Muzaffarnagar white.
FS^2	Muzaffarnagar bald.
Indian H.	Pissia Lal.
Indian K.	Pissia mundi.
Indian P.	Pissia sufeid.
Sirdar × Indian.	
Sirdar × Zuff.	

Of the Australian wheats, Etawah A, Fifes Indian, Indian H, and Indian P were too mixed to be of any use except as selection grounds for types, and, as far as the work at this farm is concerned, will be discontinued.

Indian K, Sirdar × Indian D, and Sirdar × Zuff were sufficiently pure to admit of the selection of seed for further trial.

FS^2 is referred to later.

Of the Indian wheats, the local wheats called Pissia proved to be a hopeless mixture.

Muzaffarnagar bald was a promising wheat on both *mar* and *kabar* soils. As it is apparently identical with one of Mr. Howard's pure Indian types and was not nearly pure, it was decided not to attempt to purify it but to continue it one year more in comparison with the above mentioned wheat.

Kathia apparently showed three distinct types.

The recognised bearded, red chaffed, hard red grained type has been selected for future sowing whilst the three types are under study as to whether they are really different or merely variations due to soil and climate.

Malwa wheat.—This wheat is of interest as it comes naturally into the market in times of scarcity. Like all other wheats, it was freed from obvious

impurities by hand-picking, and then turned out practically pure. The trial of this wheat will be continued.

Muzaffarnagar white wheat is being tried both for its suitability to the district and soil. The station has also been chosen as one of a series in which Muzaffarnagar wheat has been grown to test the effect of the soil and climate upon grain character, Vide Agricultural Research Institute Pusa, Bulletin No. 14 p. 4 and Memoirs Dept. of Agri. in India, Bot. series Vol II, No. 7, p. 2) an investigation which has been taken up by the Imperial Economic Botanist and the Economic Botanist, United Provinces.

The outturns of five varieties are shown below; the outturns of the mixture locally known as Safeid Pissia (this name was originally given to a recognised variety) are added for comparison.

Variety.	Mar irrigated.		Mar unirrigated.		Kabar.		Parwa.		Remarks.
	A	B	A	B	Irrigated.	Unirrigated.	Irrigated.	Unirrigated.	
Malwa ...	395	518	381	475	430	211	...	...	*Mar*, irrigated, sown 3rd December 1908, unirrigated resown on *paleo*, 13th December 1908. *Kabar*, both sown on 18th October 1908 and both irrigated once on 21st November 1908. The irrigated block received two subsequent waterings. The germination of neither block good, but the irrigated block much the better of the two.
Kathia ...	448	300	230	240	566	495	826	425	*Parwa and kabar* plots were all resown with *paleo* on 16th December 1908. The irrigated plots received two subsequent waterings. *Mar*, the unirrigated plots sown on 19th October 1908 were given one watering on 20th November 1908. The irrigated plots were sown on 3rd December 1908 and received two subsequent waterings.
Sirdar × Indian D.	323	380	...	...	800	345	395	...	*Kabar*, sown 22nd October 1908. *Mar* and *parwa* on 3rd December 1908.
Indian K ...	410	563	275	223	...	...	486	465	*Mar*, unirrigated, sown 19th October 1908. Germination poor. *Mar* irrigated on 3rd December 1908. *Parwa* resown on *paleo* on 17th December 1908.
Muzaffarnagar white.	183	468	...	...	413	281	308	...	Irrigated plots sown 3rd December 1908. Unirrigated plots resown 24th December 1908.
Safeid pissia	354	441	255	400	203	301	445	420	*Mar*, unirrigated resown 10th December 1908 on *paleo*, irrigated sown 3rd December 1908. *Kabar*, sown 18th October 1908. The unirrigated block receiving one watering in November. *Parwa*, both plots resown 14th December 1908.

The season was an unusually unfavourable one in some respects. Continuous rain in August and early September rendered preliminary preparation of the land almost impossible and the general standard of cultivation was low.

The sudden cessation of the rains resulted in a deficiency of the moisture in the seed bed, with correspondingly unsatisfactory germination, and further much of the young wheat was eaten off by an insect known locally as the "jhingur" (Gryllodes melanocephalus).

No canal water was available until early November by which date all wheats were sown.

All the plots were irrigated with the result that some were saved; others had to be ploughed up and resown when the canal was opened for a second time. Hence any comparison between the varieties is impossible, and the outturns are merely placed on record for future reference.

The wheats selected for continued trial, were selected on the basis of their general characteristics in the field rather than because they yielded well this year.

It may be mentioned that local wheats germinated under these somewhat adverse conditions somewhat better than strange varieties introduced from Cawnpore. This difference is natural and may be expected to disappear on acclimatization. It was also observed that the local seed rate (100 to 120 lb. per acre) is too high for irrigated land, though possibly well adapted to unirrigated land where the germination is, even in good years, precarious. On the irrigated plots the germination was good; ad the plants were crowded together, were weak in straw and tillered badly.

Comparison of FS² and kathia.—This wheat was originally received from the late Mr. Farrer as early ripening, but since selected and acclimatized at Cawnpore.

Mar.

Variety.	Outturn in lbs. per acre.							
	Irrigated.				Unirrigated.			
	1907.	1908.	1909.		1907.	1908.	1909.	
Kathia ...	730	410	448	300	685	517	230	240
FS² ...	520	430	153	405	553	451	190	168

Kabar.

Variety.	Outturns in lbs. per acre.					
	Irrigated.			Unirrigated.		
	1907.	1908.	1909.	1907.	1908.	1909.
Kathia ...	590	320	566	643	240	495
FS² ...	544	240	710	330	360	430

Parwa.

Variety.	Outturn in lbs. per acre.	
	Irrigated.	Unirrigated.
	1909.	1909.
Kathia ...	826	425
FS² ...	303	330

The irrigated plots on *mar* were sown on December 3rd, all other plots, originally sown in October, were resown on December 14th and 15th. This wheat ripened earlier than any other wheat on the farm. It is a poor yielder, with a light weak straw.

It is proposed to continue the test with a view to ascertaining whether it ripens sufficiently early to show a decided advantage in a "rusty" year. There is also some little doubt as to whether the wheat, now grown under this name at Orai, is the same as the original FS². It is in any case slightly mixed.

No rust appeared during the year, so that the relative resistance of the different varieties in this respect could not be observed.

The work on wheats at this station is now being carried on in conjunction with the Economic Botanist who has taken up the general study of the wheats of the province. The work on the farm will be chiefly confined to the testing of pure varieties on a fixed scale.

Gram.—Comparison of different varieties of gram.

The following varieties were compared with a view to testing the suitability of the seed for introduction, should local seed be scarce.

This was carried out in duplicate plots of one-tenth acre, on *mar, kabar, rakar* and *parwa.*

Outturn of gram varieties in lbs per acre.

Crop.	Mar.	Kabar.	Rakar.	Parwa.	Remarks.
Cawnpore gram ...	388	163	334	1,258	* Damaged by flooding due to a breach in the canal. † Damaged by wild boars.
Local gram	300	190	630	1,053	
Punjab gram	165	130	50	720	
Lalitpur black gram ...	*86	149	83	875	
Cawpore gram	515	441	59	...	
Local gram	144	335	225	...	
Punjab gram	490	215	48	...	
Lalitpur black gram ...	123*	†122	90	...	

The Cawnpore variety was distinctly superior on *mar, kabar* and *parwa.* This is the reverse of last year's experience in which local gram proved slightly the better of the two. Punjab gram did fairly well, but Lalitpur black gram proved distinctly inferior, although the damage suffered by these plots makes exact comparison impossible.

CHAPTER III.

Trial of farm-yard manure on mar.

Farm-yard manure at 100 and 200 maunds per acre was applied to duplicate plots, two unmanured plots being cultivated and sown in the same way. One plot of each pair was sown with a mixture of Kathia wheat and local gram, as last year, the other with Kathia wheat alone.

Outturn in lbs. per acre.

Treatment.	Crop.	Outturn. 1909.	Outturn. 1908.
Farm-yard manure at 100 mds. ...	Kathia and gram...	610	492
Ditto ...	Kathia ...	600	317
Farm-yard manure at 200 mds. ...	Kathia and gram...	595	...
Ditto ...	Kathia ...	472	...
Unmanured	Kathia and gram...	418	410
Ditto	Kathia ...	418	230

The increase in yield is in no way proportionate to the amount of manure applied, partly because the manure could only be applied late and partly due to the unfavourableness of the season.

This experiment will be continued.

Trial of farm-yard manure and of poudrette on kabar.

The manures were applied at the rate of 50 lbs of nitrogen per acre. Kathia wheat was sown on three pairs of duplicate plots of one-tenth acre each.

Outturn in lbs per acre.

Treatment.	Crop.	Out-turn.
Farm-yard manure at 50 lbs nitrogen per acre.	Kathia ...	453
Ditto ...	Ditto ...	315
Poudrette at 50 lbs nitrogen per acre.	Ditto ...	535
Ditto ...	Ditto ...	588
Unmanured	Ditto ...	520
Ditto	Ditto ...	343

Neither manure has shown any appreciable result, the yield of grain being determined by moisture conditions rather than by the proportion of plant food present.

Trial of poudrette and farm-yard manure on parwa.

Manures were applied at the rate of 50 lbs nitrogen per acre. Plots were one-tenth acre each, the crop being Pissia wheat.

Outturns of manured and unmanured plots in lbs per acre, grain.

Treatment.	Crop.	Out-turn.	Remarks.
Farm-yard manure, at 50 lbs nitro. per acre.	Pissia ...	780	Average increase due to manure 280 lbs per acre.
Ditto ...	Ditto ...	815	
Poudrette at 50 lbs nitrogen per acre.	Ditto ...	765	
Ditto ...	Ditto ...	428	
Unmanured	Ditto ...	533	
Ditto	Ditto ...	503	

The increase due to manure is more clearly seen than in the case of *kabar* or *mar*, and the yields, with the exception of the second poudrette plot, are more consistent.

Rotation experiment.

Object.—To test the feasibility of the rotation wheat, oats, gram, as compared with continuous wheat growing. Muzaffarnagar wheat has been chosen as a pure wheat, the behaviour of which on black soil it is desired to study when grown in rotation.

Sown on duplicate plots of one-tenth acre each.

Outturns in lbs per acre (grain).

Crop.	Mar.	Parwa.	Remarks.
Muzaffarnagar wheat ...	58	448	All sowings on *parwa* were done with *paleo*.
Canadian oats ...	325	820	The germination on *mar* was bad, especially in the case of wheat—due to lack of moisture.
Local gram... ...	528	900	
Muzaffarnagar wheat ...	73	285	
Canadian oats ...	218	765	
Local gram... ...	510	1,330	

This is the first year of the experiment.

Comparison of the Watts and Meston ploughs and local bakhar on mar, kabar and parwa Soils, &c.

Duplicate plots of one-tenth acre each.

Crop.—Kathia wheat.—

Treatment.	Outturn in lbs per acre (grain). Mar.	Kabar.	Parwa.	Remarks.
Watts ...	608	268	844	* Damaged by wild boars.
Meston ...	471	214	548	Each plot received one
Native ...	478	395	637	ploughing with the
Watts ...	573	*128	1,026	plough under trial, all
Meston ...	440	280	414	other cultivation being
Native ...	530	350	979	done by local methods.

The Watt's plough plots are distinctly better than the others, and germination was also slightly more regular probably due to the better tilth obtained. The Meston plough is apparently too light for even *parwa* soil.

There is obvious room for improvement in the local methods and implements, which in many years fail to give either decent tillage or a mellow seed bed and these trials will be extended during the coming year.

Comparison of the Surat Drill and Broad-Cast method of Sowing Cotton.

The broad-cast crop was almost a complete failure this year owing to heavy rain, and the drilled crop failed completely.

In neither of the three years, during which the trial has lasted, has anything like a fair comparision been possible and the experiment is being re-started.

B. Trials of Various Plants on Waste Land.

Spineless cactus. (Opuntia ficus Indica) **as a famine fodder.**—Plants received from Cawnpore last year and planted out on *rakar* and *parwa* towards the end of the rains, have, with few exceptions, become established, and have withstood the hot weather successfully, although they have not made much growth.

The Common Blue Agave. (Agave vera cruz) **as a famine fodder.** The plants survive but make little or no growth, and it is very doubtful if they will ever do any good on *rakar* soil.

Prosopis Juliflora.—As a possible fodder plant for waste land, was planted out late in the rains, and artificially irrigated until established. It appears to be growing satisfactorily.

Melilotus officinalis.—The trial of this plant as a fodder crop suitable to waste land was undertaken solely in response to several enquiries, resulting from a newspaper advertisement of this plant. Seed obtained from two Australian sources, and from a European seed firm was tried. The seeds germinated, but no crop was obtained even with regular irrigation. Without irrigation the plants rapidly dried up.

Two Indian varieties, M. parviflora and M. alba are both known to give good yields of fodder *with irrigation* and the former is a fairly common weed in canal irrigated lands in the doab.

Dates.—The experience of the last three years having shown that dates can be successfully established, an experimental plantation of 2,000 plants in groups of three will be put down this year to test the feasibility of establishing such plantations, and to determine the capital expenditure involved.

Experiment in the eradication of kans.—As originally planned the experiments were intended to ascertain the feasibility of destroying kans on *level land* by bunding the fields and flooding with canal water. The experiments were started in 1903, and re-arranged in 1905, when taken into the newly formed Orai farm. Since then, canal water has never been available in sufficient quantity to flood the plots completely, and the amount of rain water collected proved quite insufficient to produce any marked effect on the kans.

To the flooding was added hand picking, and the trial of the C. P. plough fitted with vertical cutter, referred to in the last year's report.

So far none of the plots have been anything like cleared of the kans, but passable crops of wheat were obtained from six of them in rabi.

Plot No.	Outturn in lbs. per acre (grain).			
	Treatment.	Crop.	Outturn.	Remarks.
1	Flooding and hand picking.	Pissia wheat	657	All plots received the same original treatment, viz., flooding, with cutting of kans.
2	Ditto ...	Ditto ...	395	
3	Ploughed with C. P. plough.	Ditto ...	363	Plots 5 and 6 naturally contain less kans than the others.
4	Ditto ...	Ditto ...	...	
5	Ploughed with bakhar ...	Ditto ...	514	Plot 4 is a large plot, still badly infested with kans in parts, and has been chosen for the trial of the large turnwrest plough.
6	Ditto ...	Ditto ...	608	
7	Same as 1 and 2 ...	Ditto ...	429	

To simple flooding the following trials have now been added :—

(1) The trial of a heavy turnwrest plough on the largest and worst plot (since October 1908).

(2) Continuation of the trial of the plough, with a vertical cutter, referred to above.

(3) The effect of *do fasli* cropping on kans.

The kans plots incidentally provided a demonstration of the value of field bunds in holding up water for rabi sowings, the germination on the kans plots being far better than on the rest of the farm, except where the weed absolutely killed out the young wheat.

The non-experimental work of this station, distribution of seed and implements, demonstration work, &c., which has previously been referred to briefly in this report, will be omitted in future and the Annual Adminstrative Report of the Department should be consulted for information under these heads.

DATED CAWNPORE,
The 2nd of July 1909.

B. C. BURT,
Deputy Director of Agriculture,
Central Circle, United Provinces.

APPENDIX A.

Character of the season.—Light falls of rain were experienced from June 22nd to July 3rd, on which date the monsoon broke. Rain was almost continuous throughout July, with the result that kharif sowings were difficult. The continuous rain in August and the first week in September (there were 27 rainy days out of 37, and no break longer than three days) damaged cotton seriously, and prevented any preliminary rabi ploughings on *mar* or *kabar*, as well as making kharif weeding impossible.

The sudden cessation of rain in September, resulted in hasty and imperfect preparation for rabi in the district generally, and a bad germination.

No canal water was available until the middle of November and a great deal of rabi was resown then, and early in December with *paleo*.

Unlike doab soils, *mar* and *kabar* soils, as cultivated locally, are frequently deficient in moisture in the first four inches, whilst retaining sufficient moisture in the lower layers to maintain a crop once germinated, practical experience during the present year bearing out the conclusions arrived at from the soil moisture determinations already referred to. Hence the importance of a timely rain, or canal irrigation, after the general preparation of land, is obvious.

Light showers of rain fell in January and February, but the total fall was too small to make any appreciable difference in rabi outturns.

The rains in April and May did some damage to cultivators' standing wheat, and to wheat on the threshing floors, resulting in an appreciable loss of bhusa and some depreciation of the grain by discoloration.

The April rains, however, made stubble ploughing on rabi land and preliminary ploughings for kharif possible, an advantage not enjoyed in ordinary years and one quickly taken advantage of by the better class cultivators.

Insect Pests.

Jhingur.—Gryllodes melanocephalus. This insect, a cricket, caused considerable damage to young wheat. It is a common insect in tahsil Orai, but has not recently been reported as doing appreciable damage until the present year.

It is apparently usually kept in check by its natural enemies, of which birds, notably the Indian *minah*, seem to be the most important. It apparently lives in cracks in the ground, and at the farm was successfully driven out by irrigation.

Sonri.—The local name for a coleopterous grub.—This insect caused considerable damage by eating off mature, or nearly mature, gram plants just below the ground. It is apparently easily disposed of by irrigation, where available, and was only observed in unirrigated fields. It was last reported as a pest in 1904. The insect belongs to the family Tenebrionidae, but has not as yet been further identified.

Illi. (or Cheda, the gram borer Chloridea obsoleta).—This insect caused considerable damage in certain areas by destroying the half-ripe gram pods.

The only practical remedy that can be suggested at present is the collection and destruction of the larvæ when they first appear on the earliest pods.

Rainfall from June 1st 1908 to May 31st 1909.

Month and dates.	Total per day.	Total per month.	Month and dates.	Total per day.	Total per month.
1908.	Inches.	Inches.	1908.	Inches.	Inches.
June 22nd ...	·31	·31	July 15th ...	1·17	...
July 1st ...	·06	...	„ 16th ...	·70	...
„ 2nd ...	·05	...	„ 17th ...	·03	...
„ 3rd ...	·40	...	„ 19th ...	1·85	...
„ 5th ...	1·40	...	„ 20th ...	·24	...
„ 6th ...	2·69	...	„ 21st ...	·07	...
„ 10th ...	·60	...	„ 22nd ...	·14	...
„ 11th ...	·06	...	„ 23rd ...	·03	...

Rainfall from June 1st 1908 to May 31st 1909.

Month and dates.	Total per day.	Total per month.	Month and dates.	Total per day.	Total per month.
1908.	Inches.	Inches.	1908.	Inches.	Inches.
July 24th ...	1·02	...	August 27th ...	·52	...
,, 25th ...	·13	...	,, 28th ...	1·11	...
,, 28th ...	·19	...	,, 29th ...	·04	...
,, 29th ...	·03	...	,, 30th ...	·13	...
,, 30th ...	·01	10·87	,, 31st ...	·03	12·97
August 1st ...	1·27	...	September 1st ...	1·79	...
,, 2nd ...	·03	...	,, 2nd ...	·19	...
,, 5th ...	·63	...	,, 4th ...	·17	...
,, 7th ...	·41	...	,, 5th ...	·37	...
,, 8th ...	·08	...	,, 6th ...	·04	2·56
			1909.		
,, 9th ...	·02	...	January 4th ...	·08	...
,, 11th ...	2·06	...	,, 14th ...	·29	...
,, 12th ...	·14	...	,, 21st ...	·01	·38
,, 14th ...	·33	...	February 15th ...	·01	...
,, 15th ...	·03	...	,, 16th ...	·18	...
,, 16th ...	·09	...	,, 24th ...	·14	·33
,, 17th ...	·30	...	April 18th ...	·27	...
,, 18th ...	·53	...	,, 21st ...	·85	...
,, 19th ...	·01	...	,, 22nd ...	1·50	...
,, 20th ...	·53	...	,, 23rd ...	·47	...
,, 22nd ...	·13	...	,, 27th ...	·19	3·28
,, 25th ...	2·90	...	May 16th ...	·09	...
,, 26th ...	2·25	...	,, 20th ...	·15	·24
			Total for the year.	30·94	...

Mean Temperature at the Orai Agricultural Station.

Month.		Under shade.		In open.		
		Maximum.	Minimum.	Maximum.	Minimum.	
June 1998 ...	First half ...	115·3	87·5	...	...	Average for 15 days.
	Second half ...	108·7	84·9	...	...	,, 14 ,,
July ,, ...	First half ...	93·7	80·2	...	...	,, 15 ,,
	Second half ...	89·6	78·0	...	...	,, 16 ,,
August ,, ...	First half ...	89·1	77·3	...	...	,, 15 ,,
	Second half ...	89·9	77·4	...	...	,, 16 ,,
September ,, ...	First half ...	93·7	76·9	...	...	,, 15 ,,
	Second half ...	98·8	71·2	...	...	,, 15 ,,
October ,, ...	First half ...	97·8	66·9	...	...	,, 15 ,,
	Second half ...	98·2	59·4	...	...	,, 16 ,,
November ,, ...	First half ...	92·7	54·3	...	...	,, 15 ,,
	Second half ..	86·3	51·0	...	...	,, 15 ,,
December ,, ...	First half ...	81·3	45·2	...	...	,, 15 ,,
	Second half ...	80·1	43·1	*98·2	*41·1	,, 16 ,,
January 1909 ...	First half ...	95·3	46·7	97·7	42·8	,, 15 ,,
	Second half ...	77·4	49·1	100·9	45·3	,, 16 ,,
February ,, ...	First half ...	78·7	49·6	99·2	44·0	,, 15 ,,
	Second half ...	87·0	58·9	103·8	48·8	,, 13 ,,
March ,, ...	First half ...	91·5	55·7	106·1	51·0	,, 15 ,,
	Second half ...	99·9	62·7	111·4	55·2	,, 16 ,,
April ,, ...	First half ...	105·3	71·9	114·7	65·7	,, 15 ,,
	Second half ...	93·2	70·3	101·7	66·1	,, 15 ,,
May ,, ..	First half ...	108·0	74·9	113·8	69·9	,, 15 ,,
	Second half ...	109·5	79·6	114·7	75·5	,, 16 ,,

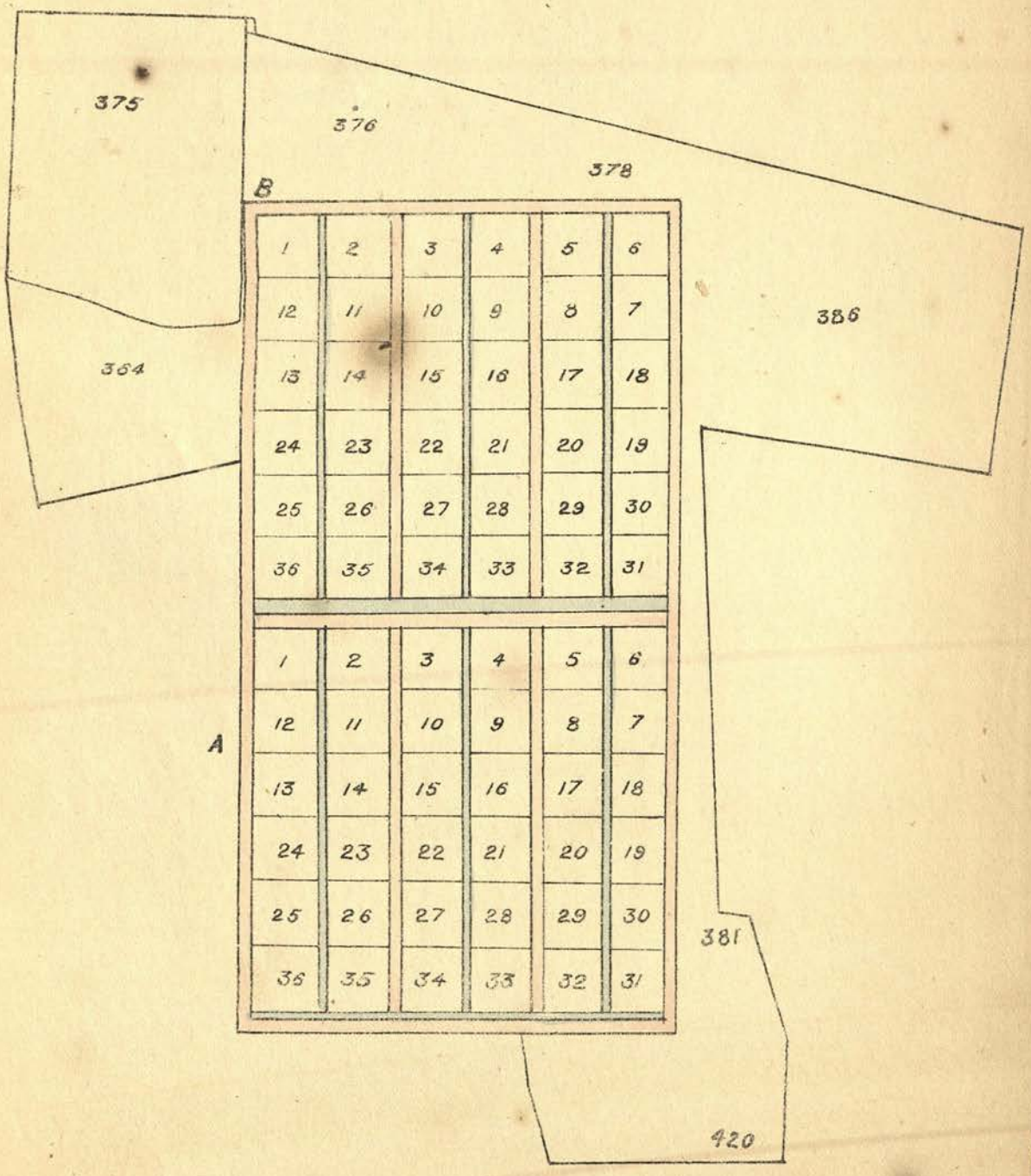
* Average for 9 days only.

MAP

OF

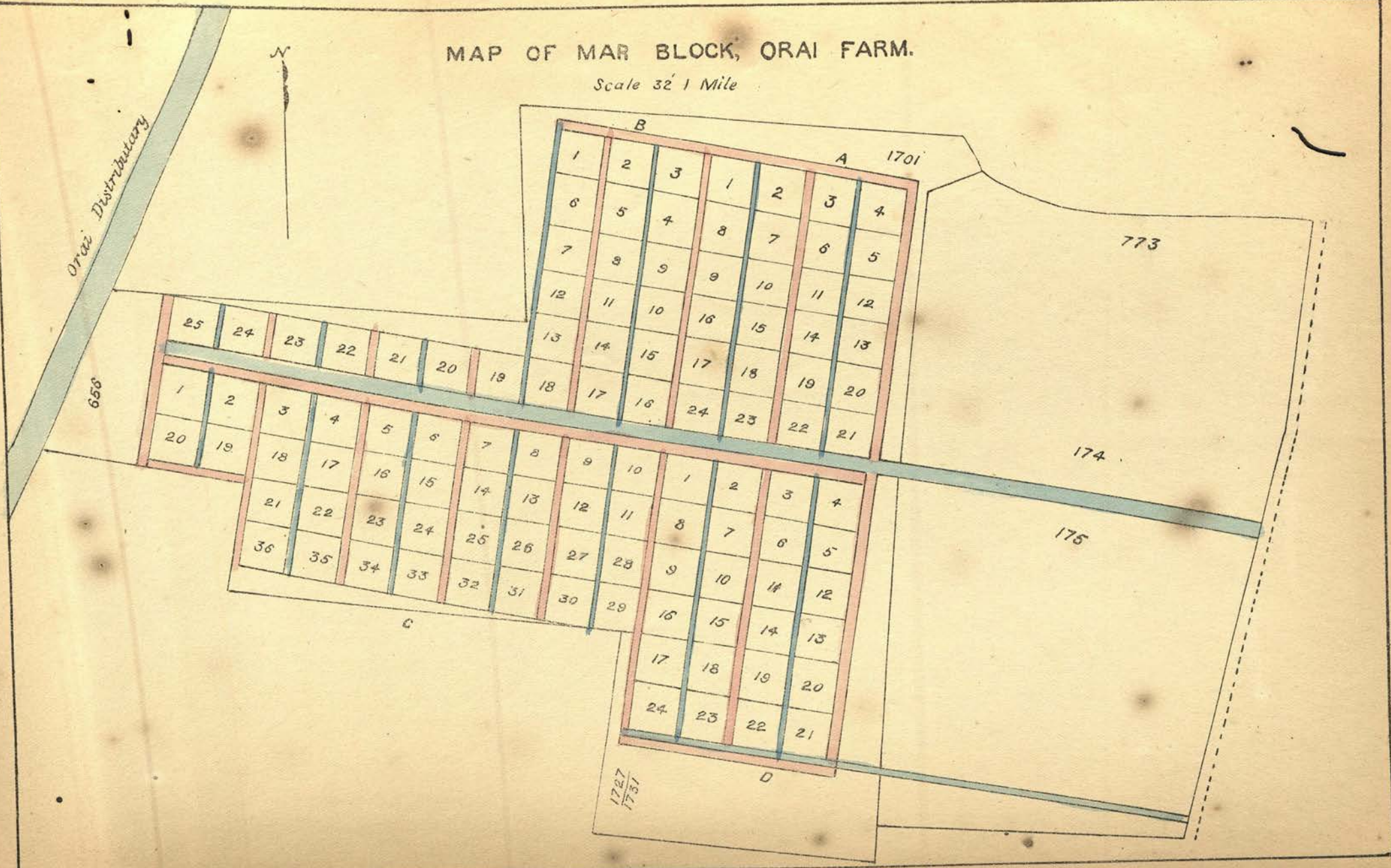
PARWA BLOCK, ORAI FARM.

Scale 32"=1 Mile



MAP OF MAR BLOCK, ORAI FARM.

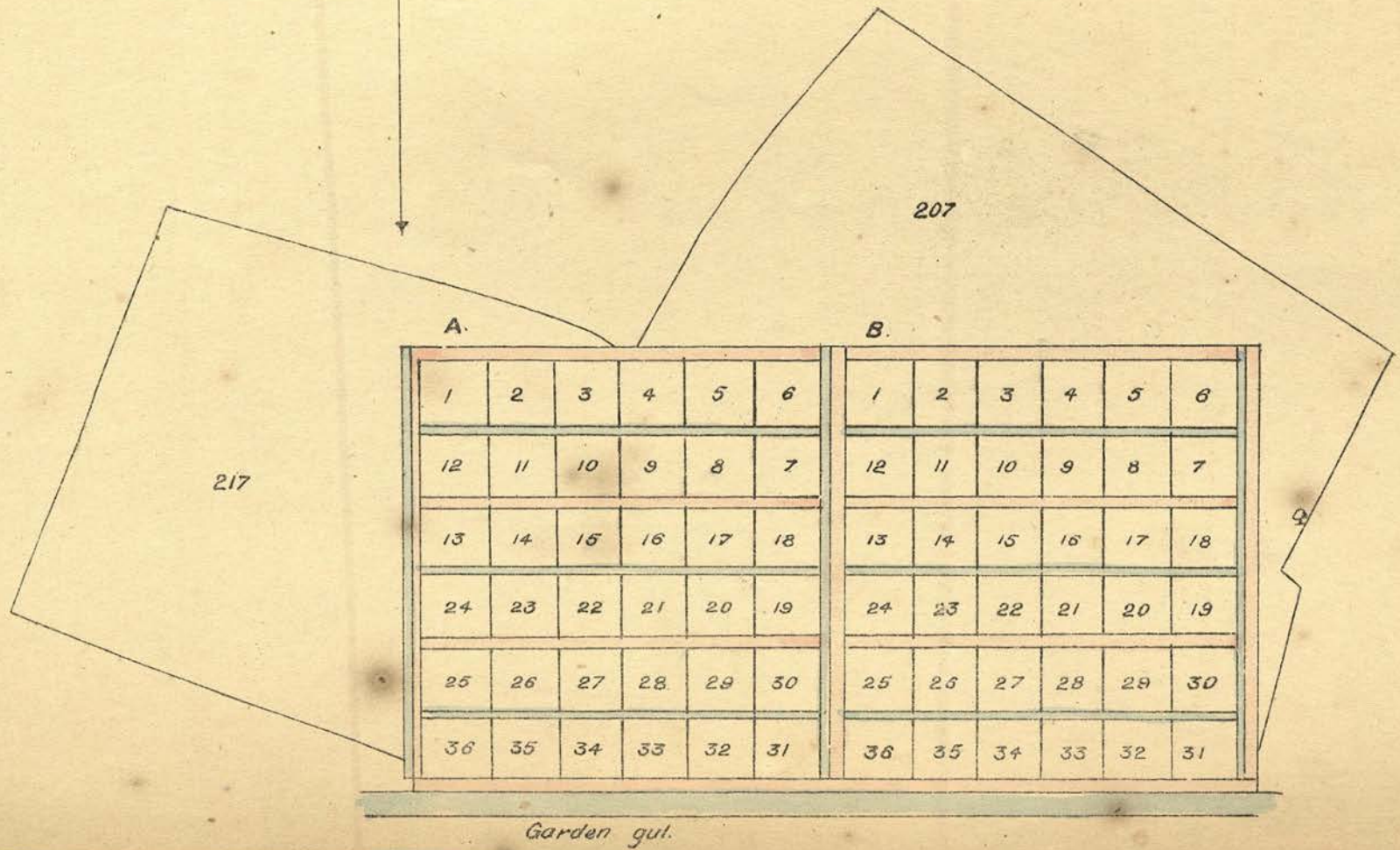
Scale 32 1 Mile



MAP OF KABAR BLOCK.

ORAI FARM

Scale 23"=1 Mile



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Hemendra Kothari

on 24 February, 2020

MAP OF

RANKER BLOCK ORAI FARM.

Scale 23"=1 Mile